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PREVALENCE OF OSTEOPOROSIS IN PATIENTS WITH TYPE-2 DIABETES MELLITUS

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Abstract

Background: *Osteoporosis and diabetes mellitus represent significant challenges in global healthcare. Individuals diagnosed with type 2 diabetes mellitus (T2DM) exhibit a heightened susceptibility to osteoporosis. However, risk of osteoporosis and its clinical significance in our local diabetic population has rarely been investigated.*

Methodology: *Study was carried out at Department of Medicine, Divisional Teaching Hospital, Mirpur, AJK. Total 185 patients of both genders having T2DM since last 12 months, having complaint of generalized body aches for at least one month and age between 18-80 years of both genders were enrolled for the study. Patients were labelled as positive for osteoporosis if BMD values showing T-score <-2.5. Entry and analysis of the data was carried out using SPSS software version 25.0.*

Results: *Most of the study patients 118 (63.8%) were female. The mean age of participants was 43.39 ± 4.61 years, ranging from 24 to 50 years. The overall prevalence of osteoporosis in the study population was 24.3% (figure 1). A statistically significantly difference (p-value ≤ 0.05) was seen for uncontrolled and controlled diabetes, age groups and duration of diabetes. No statistically significant association was noticed for any of the other effect modifiers.*

Conclusion: *Our study found 24.3% of type 2 diabetics had osteoporosis. Early screening and treatments in high-risk diabetics are crucial due to significant connections between osteoporosis and diabetic control, age, and duration. These findings underscore the importance of complete bone health treatment in diabetes therapy to prevent long-term skeletal problems.*

INTRODUCTION

Diabetes mellitus type-II is an escalating global public health concern, characterized by a substantial disease burden. It is a common metabolic condition characterized by insufficient insulin production, impaired insulin action, or both.[i] In 2019, over 463 million individuals were diagnosed with diabetes, a number projected to increase to 578 million by 2030 and exceed 700 million by 2045.[ii]

Diabetes impacts the functionality of several organs in the human body, including the heart, brain, kidneys, peripheral nervous system, eyes, and bones. The correlation between T2DM, elevated fracture risk and impaired bone quality has broadly been assumed by

researchers.[iii] The biomechanical properties and bone architecture are influenced by a multitude of variables. It was also established that hyperglycemia hinders bone remodeling through osteoblasts and osteoclasts. Furthermore, excessive hyperglycemia can induce alterations in the material characteristics of bone tissue via the accumulation of AGEs i.e. advanced glycation end products & ensuing interactions between RAGE i.e. receptor of AGEs. In contrast, insulin functions as an anabolic agent, and hyperinsulinemia may partially explain the elevated BMD (bone mineral density) observed in persons with T2DM.[iv,v] In clinical epidemiology studies, the impact of T2DM on BMD remains contentious. Many researchers have suggested that T2DM is associated with low bone density while the smaller number has claimed normal and the smaller still has shown increased BMD. Osteoporotic patients are at an augmented risk of bone fracture and this risk gets increased many folds in case of diabetic patients. The literary relationship among osteoporosis and T2DM has recently attracted considerable academic attention. [vi,vii]

Although bony disorders in patients with T2DM have been reported around the globe, a dearth of published data on our local population. However, it is of extreme importance for both physicians and patients to be aware of the prevalence rate of osteoporosis in T2DM patients for the sake of early prevention. So, on the basis of our study findings, guidelines would be devised for compulsory screening of osteoporosis among all the diabetic patients of our local population. Early detection and prevention would ultimately help to reduce the overall morbidity associated with osteoporosis among our local population having T2DM.

MATERIAL AND METHODS

This research was performed in Medicine Department of Divisional Teaching Hospital of Mirpur (Azad Jammu & Kashmir) and duration of the study was July 2024 to December 2024. The sample size was determined to be 185, with a confidence level of 95%, an absolute precision of 7%, and an estimated population proportion of 35.7%.[13]. The calculated sample size comes out as 185 T2DM patients. Consecutive non-probability technique was used for sampling. Male and female patients having T2DM since last 12 months, having complaint of generalized body aches for at least one month and age between 18-80 years of both genders were enrolled for the study from the OPD after taking fully understandable written consent from the patients or their caregivers. Patients with thyroid abnormalities, any malignancy, systemic and rheumatological inflammatory diseases, corticosteroid intake, malabsorption syndrome, and patients on immunosuppressants were excluded from the study. Patients taking supplements that contains vitamin D, or other osseous minerals were also excluded. HbA1C test and BMD analysis (DEXA scan) was done for all the patients. Patients were labelled as positive for osteoporosis if BMD values showing T-score <-2.5. Clinical findings, reports and demographic details of the patient will be gathered and recorded by the researcher. Collected data was entered and analyzed on SPSS software version 25.0 Quantitative variables such as age, BMI, HbA1C, duration of diabetes, BMD value at hip joint and spine and T-score at hip joint and spine were measured as mean ± SD. Frequency and percentages were calculated for qualitative variables e.g. sex, socioeconomic status, educational status and occupation, status of T2DM and osteoporosis. Stratification was performed for study confounders such as age, sex, BMI, socioeconomic standing, education, occupation, T2DM status, and diabetes duration. x^2-test was performed to see the statistical difference and *p*-value of ≤0.05 deemed significant.

RESULTS

A total of 185 patients with type 2 diabetes mellitus (T2DM) were included in this study. The mean age of participants was 43.39 ± 4.61 years, ranging from 24 to 50 years. Other quantitative variables such as BMI, HbA1C values, mean duration of diabetes along with BMD values and T-Score of hip and spine are presented in table Most of the study patients 118 (63.8%) were female. Majority 145 (78.4%) of the study subjects had uncontrolled diabetes. Detailed profile of demographic and clinical parameters is illustrated in table 2. The overall prevalence of osteoporosis in the study population was 24.3% (figure 1). A significantly higher proportion (p=0.028) of uncontrolled diabetic patients had osteoporosis compared to controlled diabetics. Similarly,

osteoporosis was significantly (p=0.011) more prevalent in individuals aged >35 years (95.6%) compared to those aged ≤35 years (4.4%). A statistically significant association was observed for osteoporosis among patients with diabetes duration of ≤24 months, compared to those with >24 months. This association was statistically significant (p=0.021). No statistically significant association was noticed for any of the other effect modifiers. Detailed analysis of stratification is illuminated in table 3.

Table 1: Demography, clinical and DEXA analysis details of the study population (n=185)

Quantitative Variables	Minimum	Maximum	Mean	± SD
Age (Years)	24.00	50.00	43.39	4.61
BMI (kg/m^2)	19.00	37.90	26.70	4.19
HbA1C	6.50	15.00	9.40	2.22
Duration of Diabetes (Months)	12.00	48.00	21.91	9.58
BMD Hip (g/cm^2)	-2.23	2.66	1.31	0.56
DEXA T-Score (Total Hip)	-2.94	1.91	0.23	1.26
BMD Hip (g/cm^2)	0.10	2.29	1.37	0.45
DEXA T-Score (Total Hip)	-4.69	2.87	0.29	2.24

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Table 2: Qualitative analysis of study population (n=185)

Study Variables		Frequency	Percentage (%)
Gender	Male	67	36.2
	Female	118	63.8
Diabetic Status	Controlled	40	21.6
	Uncontrolled	145	78.4
Socioeconomic Status (PKR/Month)	Upto 50K	49	26.5
	50-100K	88	47.6
	100-200K	32	17.3
	>200K	16	8.6
Occupation	Nothing	59	31.9
	Business	55	29.7
	Govt. Job	36	19.5
	Private Job	35	18.9
Age Groups	Upto 35 Years	31	16.8
	>35 Years	154	83.2
BMI Groups	<25 kg/m^2	68	36.8
	25 – 29 kg/m^2	69	37.3
	> 29 kg/m^2	48	25.9
Duration of Diabetes	Upto 24 Months	131	70.8
	>24 Months	54	29.2
Education	Illiterate	57	30.8
	School Level	100	54.1
	College/University Level	28	15.1

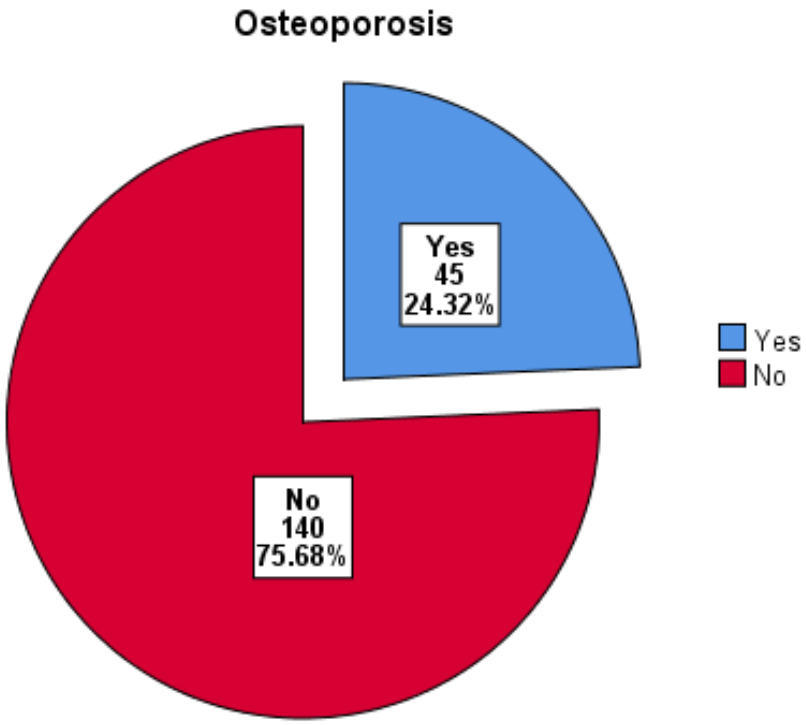

Figure 1: Frequency of osteoporosis among the patients of type 2 diabetes mellitus

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Table 3: Osteoporosis among the patients of type 2 diabetes mellitus (Stratification on the basis of various study confounders)

Study Variables		Osteoporosis		*p*-Value Chi-Square Test
		Yes	No	
Gender	**Male**	17 (37.8%)	50 (35.7%)	0.802
	Female	28 (62.2%)	90 (64.3%)	
Diabetic Status	**Controlled**	15 (33.3%)	25 (17.9%)	0.028
	Uncontrolled	30 (66.7%)	115 (82.1%)	
Socioeconomic Status (PKR/Month)	**Upto 50K**	11 (24.4%)	38 (27.1%)	0.539
	50-100K	22 (48.9%)	66 (47.1%)	
	100-200K	06 (13.3%)	26 (18.6%)	
	>200K	06 (13.3%)	10 (7.1%)	
Occupation	**Nothing**	12 (26.7%)	47 (33.6%)	0.241
	Business	11 (24.4%)	44 (31.4%)	
	Govt. Job	09 (20.0%)	27 (19.3%)	
	Private Job	13 (28.9%)	22 (15.7%)	
Age Groups	**Upto 35 Years**	2 (4.4%)	29 (20.7%)	0.011
	>35 Years	43 (95.6%)	111 (79.3%)	
BMI Groups	**<25 kg/m^2**	18 (40.0%)	50 (35.7%)	0.385
	25 – 29 kg/m^2	13 (28.9%)	56 (40.0%)	
	> 29 kg/m^2	14 (31.1%)	34 (24.3%)	
Duration of Diabetes	**Upto 24 Months**	38 (84.4%)	93 (66.4%)	0.021
	>24 Months	07 (15.6%)	47 (33.6%)	
Education	**Illiterate**	12 (26.7%)	45 (32.1%)	0.782
	School Level	26 (57.8%)	74 (52.9%)	
	College/University Level	07 (15.6%)	21 (15.0%)	

DISCUSSION

Osteoporosis and diabetes are both metabolic diseases, and the relationship between the two is complex. Furthermore, it has now been shown a highly significant relationship of race/ethnic differences with the prevalence of osteoporosis.

Diabetes has been listed as a secondary osteoporosis cause case, but osteoporosis is not actually screened in the way that other complications are in clinical practice.[viii] Osteoporosis can cause decreased quality of life, and disability from hip and vertebral fractures. With increasing life expectancy, the incidence of fractures continues to rise around the world as a natural consequence.[ix] Hip fracture in particular was associated with increased mortality and morbidity.[x,xi] This study was conducted to observe the burden of this morbidity in our local diabetic population, and our findings indicate that osteoporosis is a common comorbidity in our local patients with T2DM, particularly among uncontrolled diabetics and older individuals. These findings are in line with various past studies. Recently conducted systemic reviews have noticed that the cumulative prevalence of osteoporosis among T2DM patients is around 25-40% among Asian population.[xii] Recently, Li T and other reported that 35.77% of T2DM patients have diagnosed with osteoporosis in China.[xiii]

The current study revealed that 24.3% of patients with type 2 diabetes mellitus (T2DM) were diagnosed with osteoporosis, underscoring the considerable prevalence of osteoporosis within this demographic. This corresponds with prior studies, [xiv,xv] demonstrating that T2DM is a significant risk factor for the decline of bone health, even in the presence of normal or elevated bone mineral density (BMD) relative to non-diabetic persons. The fundamental mechanisms include persistent hyperglycemia, insulin resistance, inflammation, and advanced glycation end-products (AGEs), all of which lead to bone fragility and heightened fracture risk.

Our results indicated that osteoporosis was more prevalent in females (62.2%) compared to males (37.8%); however, this disparity was not statistically significant (p=0.802). This is consistent with established evidence that postmenopausal women are at greater risk of osteoporosis due to estrogen deficiency, which accelerates bone resorption and reduces bone formation. However, in T2DM, the risk of osteoporosis in men is also substantial due to poor glycemic control, reduced insulin levels, and increased oxidative stress, all of which impair bone metabolism. The non-significant association suggests that both genders with T2DM are at risk, and screening strategies should not be limited to females alone.[xvi,xvii]

A significant association was observed between diabetic control and osteoporosis (p=0.028), with 66.7% of osteoporosis cases occurring in uncontrolled diabetics compared to 33.3% in controlled diabetics. Poor glycemic control is known to impair osteoblast function, increase bone resorption, and compromise bone microarchitecture. Chronic hyperglycemia also leads to non-enzymatic glycation of collagen in bone, reducing its elasticity and increasing susceptibility to fractures. These findings reinforce the importance of tight glycemic control in preserving bone health and preventing osteoporosis-related complications in T2DM patients.[xviii,xix]

On the other hand, a significant association was found between age and osteoporosis (p=0.011), with 95.6% of osteoporosis cases occurring in individuals above 35 years. Aging is a well-documented risk factor for osteoporosis due to gradual bone loss, hormonal changes, and reduced calcium absorption. In T2DM patients, age-related decline in bone quality is further exacerbated by chronic hyperglycemia, insulin resistance, and impaired bone healing mechanisms. These findings emphasize the need for early osteoporosis screening and intervention in aging T2DM populations.[xx,xxi]

A significant association was observed between duration of diabetes and osteoporosis (p=0.021). The majority of osteoporosis cases (84.4%) were found in patients with diabetes duration ≤ 24 months, whereas 15.6% of osteoporosis cases were found in those with diabetes >24 months. This finding is somewhat unexpected, as longer duration of diabetes has been linked to higher osteoporosis risk due to prolonged exposure to hyperglycemia and metabolic derangements. However, the higher osteoporosis prevalence in recently diagnosed patients may reflect pre-existing bone loss before diabetes diagnosis or could indicate early metabolic bone complications in uncontrolled diabetes. Future studies with longitudinal follow-ups are required to better understand this pattern.[xxii,xxiii]

The findings of this study suggest that osteoporosis is a significant comorbidity in type 2 diabetic patients, particularly among older individuals, uncontrolled diabetics, and those with a shorter duration of diabetes. Given the asymptomatic nature of osteoporosis until a fracture occurs, routine screening with DEXA scans should be considered in high-risk

T2DM patients, particularly those with poor glycemic control and older age. Additionally, interventions such as calcium and vitamin D supplementation, lifestyle modifications, and tailored exercise programs may help reduce osteoporosis risk and prevent fractures in diabetics.

Despite its strengths, this study has some limitations. First, the sample size was relatively small, which may have impacted the statistical significance of certain associations. Second, factors such as dietary calcium intake, vitamin D levels, and physical activity were not assessed, which may play a critical role in osteoporosis development. Future studies should incorporate larger sample sizes, multi-center designs, and longitudinal follow-ups to further validate these findings and explore additional risk factors for osteoporosis in T2DM.

CONCLUSION

In conclusion, osteoporosis is a common comorbidity in type 2 diabetes mellitus, with a prevalence of 24.3% in our study population. Notable correlations emerged between osteoporosis and factors such as diabetic control, age, and the duration of diabetes, underscoring the necessity for early screening and intervention in patients with diabetes who are at high risk. The results highlight the importance of integrating thorough bone health management into diabetes care protocols to avert long-term skeletal issues.

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